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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/871,463	05/31/2001	Charles R. Spinner III	01-P-002 (STMI01-00013)	9805
30425	7590	08/24/2004	EXAMINER	
STMICROELECTRONICS, INC. MAIL STATION 2346 1310 ELECTRONICS DRIVE CARROLLTON, TX 75006			WARREN, MATTHEW E	
			ART UNIT	PAPER NUMBER
			2815	

DATE MAILED: 08/24/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/871,463	Applicant(s) SPINNER ET AL.	
	Examiner Matthew E Warren	Art Unit 2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 08 December 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 8-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 8-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>1/21/04</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

This Office Action is in response to the Appeal Brief filed on December 8, 2003.

Response to Appeal

In view of the Appeal Brief filed on December 8, 2003, PROSECUTION IS HEREBY REOPENED. A new grounds of rejection is set forth below.

To avoid abandonment of the application, appellant must exercise one of the following two options:

(1) file a reply under 37 CFR 1.111 (if this Office action is non-final) or a reply under 37 CFR 1.113 (if this Office action is final); or,

(2) request reinstatement of the appeal.

If reinstatement of the appeal is requested, such request must be accompanied by a supplemental appeal brief, but no new amendments, affidavits (37 CFR 1.130, 1.131 or 1.132) or other evidence are permitted. See 37 CFR 1.193(b)(2).

Election/Restrictions

The previous restriction pertaining to an intermediate device has been withdrawn. However, the first restriction between the method and device will be reinstated because it has been determined that such a restriction is still proper for this application.

Restriction to one of the following inventions is required under 35 U.S.C. 121:

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- I. Claims 8-20, drawn to a semiconductor device, classified in class 257, subclass 773.
- II. Claims 1-7, drawn to a method of making a semiconductor device, classified in class 438, subclass 1+.

The inventions are distinct, each from the other because of the following reasons:

Inventions II and I are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case etching, instead of chemical mechanical polishing, could be used to remove portions of the protective barrier layer.

Because these inventions are distinct for the reasons given above and the search required for Group II is not required for Group I, restriction for examination purposes as indicated is proper.

Applicant is advised that the reply to this requirement to be complete must include an election of the invention to be examined even though the requirement be traversed (37 CFR 1.143).

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 8 and 10-14 are rejected under 35 U.S.C. 102(e) as being anticipated by Zhao et al. (US 6,060,787).

In re claim 8, Zhao et al. shows (fig. 3A) a portion of an integrated circuit comprising: a dielectric layer (302) over a substrate, a conformal tungsten layer (306) over the dielectric layer and within openings within the dielectric layer. A protective barrier (307) of tungsten is formed over the tungsten layer and within the openings. The barrier layer comprises a material for which removal by chemical mechanical polishing is primarily mechanical because the tungsten barrier layer (307) resists attack by the polishing slurry (col. 6, lines 3-19). Although Zhao does not specifically call the protective tungsten layer (307) a barrier layer, however tungsten is well known to provide the barrier function according to the teachings of Horak et al. (col. 5, lines 34-52).

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In re claim 10, Zhao et al. shows (fig. 3A) that the portions of the tungsten layer within the openings are thicker than the portions of the tungsten layer over the dielectric layer.

In re claims 11 and 12, Zhao et al. shows (fig. 3A) that the protective barrier layer (307) overlies the entire tungsten layer (306). Zhao et al. also shows (fig. 3B) that the protective barrier layer overlies portions of the tungsten layer within the openings but not portions of the tungsten layer over the dielectric layer.

In re claims 13 and 14, Zhao et al. discloses (col. 5, lines 20-24 and col. 5, lines 50-55) that the tungsten layer has thickness between 4500 and 8000 Angstroms and the protective barrier layer has a thickness between 100 and 800 Angstroms.

Claims 16-18 are rejected under 35 U.S.C. 102(e) as being anticipated by Horak et al. (US 6,436,814 B1).

In re claim 16, Horak et al. shows (fig. 5) a portion of an integrated circuit structure comprising: a dielectric layer (220) having an opening, tungsten (230) within the opening, and a portion of a protective barrier layer (510) over a central region of the tungsten and within the opening. The protective barrier layer inherently has the property of a material for which removal of chemical mechanical polishing is primarily mechanical since the same materials are used for the applicant's claimed invention.

In re claim 17, Horak et al. shows (fig. 5) that an upper surface of the tungsten is exposed around a portion of the protective barrier layer.

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In re claim 18, Horak et al. discloses (col. 5, lines 34-52) that the protective barrier layer is titanium or titanium nitride.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhao et al. (US 6,060,787) as applied to claim 8 above, and further in view of Horak et al. (US 6,436,814 B1).

In re claim 9, Zhao et al. discloses that the protective barrier is a tungsten film but does not explicitly show that the barrier film is a titanium or titanium nitride. Horak et al. discloses (col. 5, lines 34-52) that titanium or titanium nitride is a suitable material for a barrier layer and is interchangeable with a tungsten layer. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the tungsten barrier layer of Zhao by substituting it with titanium because Horak teaches that titanium is a suitable barrier layer for a tungsten plug.

Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhao et al. (US 6,060,787) as applied to claim 8 above, and further in view of Van Buskirk et al. (US 6,346,741 B1).

Zhao et al. shows all of the elements of the claims except the opening in the dielectric being sized to form a capacitive electrode from the tungsten within the opening. Van Buskirk et al. shows. (fig. 1H) shows a capacitor device comprising a tungsten electrode contact (18) and a tungsten top electrode (44) formed in dielectric layer (18 and 35) openings. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the tungsten interconnect of Zhao by incorporating that interconnect as a capacitor electrode because Van Buskirk teaches that tungsten interconnects suitably function as capacitor electrodes.

Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Horak et al. (US 6,436,814 B1) as applied to claim 16 above, and further in view of Joshi et al. (US 5,889,328).

Horak et al. shows all of the elements of the claims except the tungsten and barrier layer form an upper surface which is planar with an upper surface of the dielectric layer. Joshi et al. shows (fig. 7B) shows an interconnect structure in which a low resistive metal layer (16) (which includes tungsten) and capping layer (17) (being titanium is formed in a via hole and is coplanar with an upper surface of a dielectric layer (15) (col. 10, lines 13-30). Such a configuration results in conductors that are corrosion-free, resist electromigration wear, and reduced cumbersome dielectric planarization steps (col. 3, lines 50-55). Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the tungsten interconnect of Horak by forming the tungsten and titanium barrier layer to be coplanar

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with an upper surface of a dielectric layer as taught by Joshi to form conductors that are corrosion-free, that resist electromigration wear, and have minimal dielectric planarization steps.

Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Horak et al. (US 6,436,814 B1) as applied to claim 16 above, and further in view of Van Buskirk et al. (US 6,346,741 B1).

Horak et al. shows all of the elements of the claims except the opening in the dielectric being sized to form a capacitive electrode from the tungsten within the opening. Van Buskirk et al. shows. (fig. 1H) shows a capacitor device comprising a tungsten electrode contact (18) and a tungsten top electrode (44) formed in dielectric layer (18 and 35) openings. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the tungsten interconnect of Horak by incorporating that interconnect as a capacitor electrode because Van Buskirk teaches that tungsten interconnects suitably function as capacitor electrodes.

Conclusion

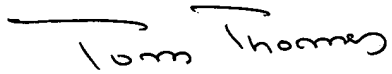
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew E Warren whose telephone number is (571) 272-1737. The examiner can normally be reached on Mon-Thur and alternating Fri 9:00-5:00pm.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (571) 272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

MEW
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August 19, 2004


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